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(71) Applicant: **GOLDSTAR CO. Ltd.**
20, Yoido-Dong, Youngdungpo-Gu
Seoul(KR)

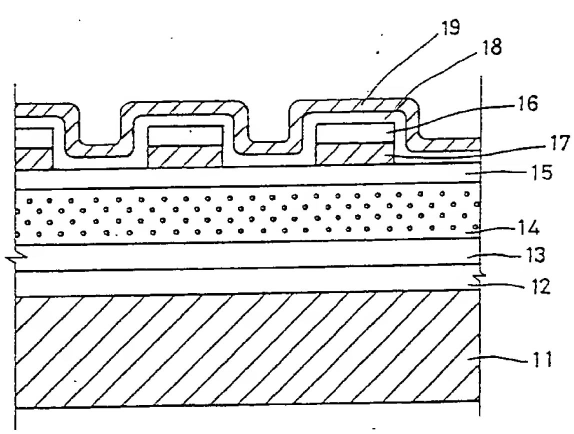
(72) Inventor: **Jae-Hwa, Ryu**
10-82, Shinrimbon-Dong
Kwanak-Gu, Seoul(KR)

(74) Representative: **Patentanwaltsbüro Cohausz & Florack**
Schumannstrasse 97
W-4000 Düsseldorf 1(DE)

(54) **Fabrication method and structure of a thin film electroluminescent device.**

(57) Disclosed is a thin film electroluminescent device of this invention comprising a transparent substrate, a transparent electrode, a fluorescent layer emitting a light when being charged with a certain voltage, a first and second insulating layer being laminated on the top and the bottom of the fluorescent layer to make a dopant be excited and emit a light efficiently, a first light absorbing layer being laminated on the second insulating layer to improve the function of contrast of the device of electroluminescence, a rear electrode formed on the first light absorbing layer at regular intervals, a rear insulating layer being laminated on the rear electrode to prevent the current from leaking from the rear electrode, and a second light absorbing layer being laminated on the rear insulating layer to blacken the etched portion of the first light absorbing layer.

FIG. 3



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FIELD OF THE INVENTION

This invention relates to a thin film electroluminescent display device and a method for fabricating it.

TECHNICAL BACKGROUND OF THE INVENTION

Generally a thin film electroluminescent display device has a structure wherein a insulating layer is formed on both sides of a fluorescent layer so as to induce a high electrical field around the fluorescent layer when a certain voltage is loaded on both sides of the fluorescent layer. In a conventional structure of the displaying device of thin film electroluminescence as shown in Fig. 1, a transparent substrate 1 laminates a transparent electrode 2, a first insulating layer 3, a fluorescent layer 4, and a second insulating layer 5 sequentially on itself, and a rear electrode 6 is formed on the second insulating layer 5 at regular intervals.

The transparent electrode 2 and the rear electrode 6 are arrayed in a form of matrix by line etching at regular intervals and the displaying device of the thin film electroluminescence is working by On/Off switch at cross points of the matrix selectively. A strong electrical field is induced by loading a alternative voltage between the transparent electrode 2 and the rear electrode 6, which makes the electrons of shallow level or deep level of a interfaced surface between the insulating layer 3 or 5 and the fluorescent layer 4 to be accelerated toward a opposite polarity, wherein the accelerated electrons strike Mn^{2+} of the fluorescent layer 4 composed of zinc sulphate ZnS and Manganese Mn. After being struck, an electron in valence band of the Mn^{2+} excited the conduction state is returned to the valence band ,and then a light with a specific wavelength of 585 nm is radiated from the fluorescent layer.

By selectively applying a voltage on the transparent electrode 2 and the rear electrode 6, the light radiates to the transparent substrate 1 and the rear electrode 6, and the light directed to the rear electrode 6 is reflected and sent to the transparent substrate 1.

Accordingly an image is formed on the displaying device of the thin film electroluminescence by the principle described as the above.

However,in a conventional device of electroluminescence shown in Fig. 1, it is unable to prevent a light reflected on the rear electrode of which light received from the displaying device and the fluorescent layer because the fluorescent layer 4 has not a light absorbing layer on its rear side. Therefore the performance of the displaying device is deteriorated because a contrast among pixels being on and off becomes poor.

In another conventional device of electroluminescence shown in Fig.2, a light absorbing layer 7 made of SiNx is introduced to eliminate the above mentioned problem. And the dielectric condition of the light absorbing layer 7 is to have a specific resistance of more than $10^8\,\Omega cm$. However it is unable to manufacture the layer 7 of SiNx having light absorbing capacity of more than 80 % and specific resistance of more than $10^5\,\Omega cm$ by changing the value of 'x' of SiNx. Accordingly the specific resistance being less than $10^5\,\Omega cm$, the adjacent pixels interfere with one another by leaking electrical current. And the layer of SiNx being not close fitting reduces a life of the device of thin film electroluminescence.

SUMMARY OF THE INVENTION

The object of this invention is to provide a displaying device of electroluminescence of which life being extended by preventing the adjacent pixels from interfering with one another owing to leaking current and of which function being improved by preventing a light from being reflected on a rear electrode with laminating a light absorbing layer.

According to the present invention, there is provided a thin film electroluminescent device wherein a first light absorbing layer of SiNx being laminated on a second insulating layer and a rear electrode layer being laminated on the first light absorbing layer. The rear electrode layer is etched by wet process at regular intervals whereby a portion of the first light absorbing layer being exposed and the exposed portion being etched by a ionic reaction process. Thereafter a rear insulating layer is laminated on the etched surface and the rear electrode, and a second light absorbing layer of carbon is laminated on the rear insulating layer.

The thin film electroluminescent device of this invention comprises a transparent substrate, a transparent electrode, a fluorescent layer for emitting a light when being charged with a certain voltage, a first and second insulating layer laminated on the top and the bottom of the fluorescent layer to make a dopant be excited and emit a light efficiently, a first light absorbing layer laminated on the second insulating layer to improve the function of contrast of a displaying element of electroluminescence, a rear electrode formed on the first light absorbing layer at regular intervals, a rear insulating layer laminated on the rear electrode to prevent a current leaking of the rear electrode, and a second light absorbing layer laminated on the rear insulating layer for preventing blackening of the etched portion of the first light absorbing layer.

The present invention will now be described more specifically with reference to the drawings attached only by way of example.

BRIEF DESCRIPTION OF DRAWINGS

Fig.1 and Fig.2 show sectional views of a conventional thin film electroluminescence device; and

Fig.3 shows a sectional view of an inventive thin film electroluminescence device.

DETAILED DESCRIPTION OF A CERTAIN PREFERRED EMBODIMENT

Referring to Fig.3, a transparent electrode 12 is laminated on a transparent substrate 11, and a first insulating layer 13 of 200 nm thickness of Si_3N_4 made from Silicon target and N_2 gas by radio frequency Magnetron Sputtering process in a gas reactive furnace is laminated on the transparent electrode 12.

A fluorescent layer 14 formed on the first insulating layer 13 is made from ZnS pellet doped with 1 mol % of Manganese (Mn) by EB process and having heat treatment in a vacuum space of 450 C. for 1 hour so as to secure a fine crystallization, a uniform distribution of doping and a quality adhesiveness to the first insulating layer 13.

A second insulating layer of SiON 15 is made from Silicon target and $O_2 + N_2$ gas by radio frequency (RF) Magnetron Sputtering process in a reactive gas furnace.

A first light absorbing layer of 100-200 nm thickness 17 is made from SiN_x short of Nitrogen, of which 'x' value is 0.1-0.5 preferably less than 1.33, and laminated on the second insulating layer 15.

A rear electrode layer 16 is laminated on the first light absorbing layer 17. Thereafter the rear electrode 16 and the first light absorbing layer 17 are etched by wet method and reactive ion method with photo resist successively. The reactive ion etching is performed in the mixture of CF_4 and O_2 gases having the ratio of four to one with 100 watt high frequency power at the pressure of 50 mm Torr for about two and half minutes.

And a rear insulating layer 18 is laminated, after eliminating the photoresist, on the rear electrode 16 under the same conditions as those in laminating the second insulating layer 15.

Finally a carbon of 0.1-1 m thickness is coated on the rear insulating layer 18 by arc discharge, being a second light absorbing layer 19.

In the inventive thin film electroluminescent device, a high electrical field of MV/cm is induced to the fluorescent layer 14 by charging a voltage of 200 Volts between the transparent electrode 12 and the rear electrode 15. The induced electrical field make a electron strike Mn with one another internally and the Mn exited by being struck emits a yellow light. The light radiated backwards is absorbed by the first and second light absorbing layer 17 and 19, and the light being radiated forward is displayed through the substrate 11.

For preventing the current leaking among adjacent rear electrodes through the light absorbing layer 7 as shown in Fig.2, the first light absorbing layer 17 is etched at the same size of the rear electrode 16 and the rear insulating layer 18 of the same material of the second insulating layer 15 is laminated on the rear electrode 16 as shown in Fig.3. Further the second light absorbing layer 19 is laminated on the rear insulating layer 18 to prevent blackening of the etched portion of the first light absorbing layer.

In conclusion, the present invention features that the weak adhesiveness owing to different materials is prevented because the material SiN_x of the first light absorbing layer 17 is the same kind of material SiON of the second light absorbing layer 19, the current leaking through the first light absorbing layer 17 is prevented by etching the layer at the same size of the rear electrode, and the contrast is improved by laminating the rear insulating layer 18 and the second light absorbing layer 19 to blacken the rear side when the thin film electroluminescent device being operated.

Claims

1. A method for fabricating a thin film electroluminescent device comprising the steps of:
   a) laminating a transparent electrode on a transparent substrate;
   b) laminating a first insulating layer on said transparent electrode layer;
   c) laminating a fluorescent layer on said first insulating layer to emit a light;
   d) laminating a second insulating layer on said fluorescent layer;
   e) laminating a SiN_x layer on said second insulating layer to form a first light absorbing layer;
   f) forming a rear electrode on said first light absorbing layer;
   g) laminating a rear insulating layer on said rear electrode after etching said rear electrode layer by wet method and said first light absorbing layer by a ionic reaction method at regular intervals respectively; and
   h) laminating a second light absorbing layer on said rear insulating layer.

2. A fabricating method of a thin film electroluminescent device as claimed in Claim 1, wherein said first light absorbing layer consists of SiN_x and the value of 'x' is within 0.1-0.5.

3. A method for fabricating a thin film electroluminescent device as claimed in Claim 1, wherein said second light absorbing layer consists of carbon.

4. A method for fabricating a thin film electroluminescent device as claimed in Claim 1, wherein said first insulating layer consists of a Si_3N_4 film with a thickness of 200 nm formed by RF magnetron reactive sputtering method using Silicon target in a N_2 gas reaction furnace.

5. A method for fabricating a thin film electroluminescent device as claimed in Claim 1, wherein a fluorescent layer being made from zinc sulphate pellet (ZnS) doped with 1 mol % manganese and having heat treatment in 450 C vacuum space for one hour.

6. A method for fabricating a thin film electroluminescent device as claimed in Claim 1, wherein the step of reactive ion etching for forming said rear insulating layer is performed in the mixture of CF_4 and O_2 gases having the ratio of four to one with 100 W radio frequency power at the pressure of 50 mm Torr for two and half minutes.

7. A structure of a thin film electroluminescent device, comprising:
   a) a substrate;
   b) a transparent electrode formed on said substrate (11);
   c) a fluorescent layer for emitting a light when being charged;
   d) a first and a second insulating layers respectively formed on the bottom and the top of said fluorescent layer so as to effectively excite the dopants in said fluorescent layer and make them emit a light;
   e) a first light absorbing layer formed on said second insulating layer to improve the effect of contrast by preventing a light reflected from a rear electrode;
   f) a rear electrode formed on said first light absorbing layer at regular intervals;
   g) a rear insulating layer formed on said rear electrode to prevent the current leaking; and
   h) a second light absorbing layer formed on said rear insulating layer for preventing blackening of the etched portion of said first light absorbing layer.

8. A structure of a thin film electroluminescent device as claimed in Claim 7, wherein said first light absorbing layer consists of SiNx and the value of 'x' is within 0.1-0.5.

9. A structure of a thin film electroluminescent device as claimed in Claim 7, wherein the material of said rear insulating layer is the same kind of the material of said second insulating layer.

10. A structure of a thin film electroluminescent device as claimed in Claim 7, wherein a second light absorbing layer consists of carbon.

11. A structure of a thin film electroluminescent device as claimed in Claim 7 or 8, wherein said first light absorbing layer has the thickness of 100-200 nm.

12. A structure of a thin film electroluminescent device as claimed in Claim 7, 8 or 11, wherein said first light absorbing layer is etched at the same size of said rear electrode.

FIG. 1

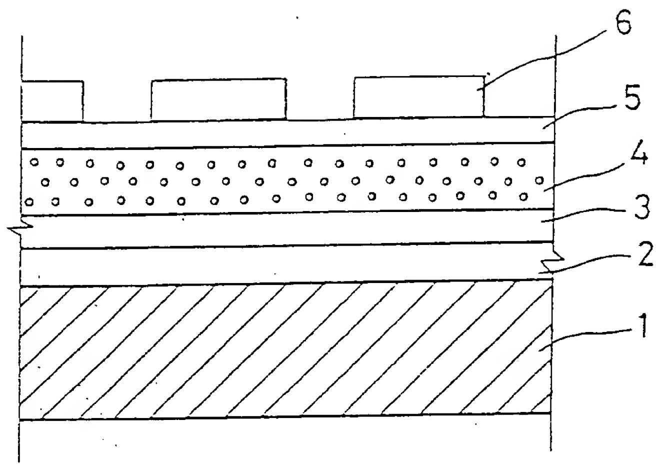

FIG. 2

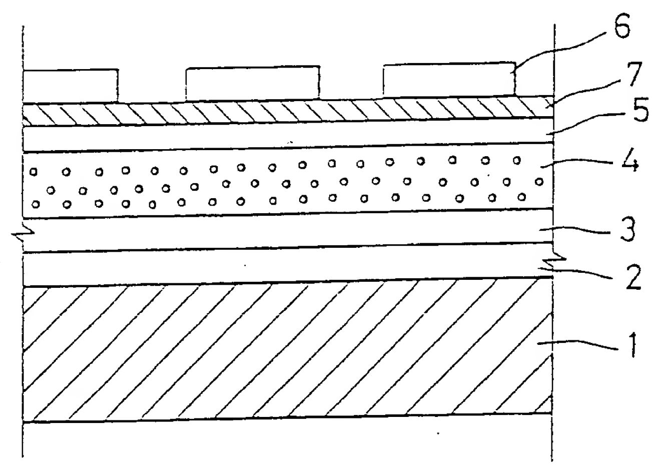

FIG. 3